CHAPTER 10

DUCTS

Section I. USES AND TYPES

10–1. Uses

Ducts are used to distribute air to the point within the structure where it is needed. In heating and cooling habitable structures, large quantities of all are required, but noticeable drafts are not desirable, so duct systems are designed to move the air at relatively low velocities and pressures. Under these conditions, ducts must be large in cross section, but do not require a great deal of structural strength.

10–2. Types

Two types of duct materials are in general use. They are classified as metal ducts and nonmetallic ducts. The metal ducts generally are made of sheet metal, and can be used without restriction wherever ducts are used. Nonmetallic ducts are generally made of fiber glass, and are not recommended for use where they will be exposed to the weather (as on roofs or on the outside of a building) or to a great deal of moisture. Aside from this restriction, the duct materials can, from the point of view of design, be used interchangeably. However, unless there is a requirement that the duct be insulated, the metal ducts will cost less.

Section II. METAL DUCTS

10–3. Material Used

Sheet metal is used in the fabricating of ducts for heating, ventilating and air conditioning. Several types are commonly used:

a. Galvanized Iron. Galvanized iron is iron or steel coated with a thin layer of zinc to make it corrosion-resistant. It is the most frequently used sheet metal material.

b. Tin Plate. Sheets of iron, such as may be used for roofing work, are frequently coated with a thin layer of tin, in which case they are called bright tin. They may also be coated with a tin-lead alloy, in which case they are known as ternplate. The coating on ternplate is usually 25 percent tin and 75 percent lead, and the thickness of the coating is indicated by the number of pounds of alloy per hundred pounds of iron. For example, 30-pound ternplate consists of 30 pounds of tin-lead alloy coating to each 100 pounds of sheet iron.

c. Aluminum. Aluminum sheets of the 2S and 3S type alloy and three-fourth hard temper are readily workable and can be used for duct work, roofing, guttering, and other purposes. Although aluminum sheets do not have the strength and rigidity of steel sheets, they do have the advantages of lighter weight, better appearance, and superior resistance to corrosion under most conditions. They also take paint well. Although aluminum cannot be soldered easily, joints can be made in the same manner as in steel sheets; it can be riveted, and the heavier-gage sheets can readily be welded.

d. Copper. Sheet copper has great resistance to corrosion and has greater strength and hardness than sheet aluminum. It may be easily soldered, brazed, or welded. It is used for roofing, guttering, and the manufacture of some miscellaneous equipment requiring both strength and resistance to corrosion.

e. Stainless Steel. Stainless steels are alloys of steel and chromium (and sometimes nickel)

with or without silica. They have the strength and hardness of acids such as fruit acid. They can be formed and welded. When available, stainless steel is the preferred material for kitchen sinks, drain boards, hoods, and other equipment where hardness, resistance to corrosion, and appearance are important.

10-4. Gage

The thickness of metal sheets and wire is designated by standard U.S. gage. While gage numbers range from 0000000 to 88, the thicknesses most commonly used in sheet metal work range from 14 to 28 gage. Thicknesses and weights for each gage are listed in table N-1. The thickness of metal sheets and wire may be determined by a slotted metal gage. The number of the slot into which the metal fits snugly without forcing indicates the gage of the metal.

10-5. Wire

Galvanized iron wire is most commonly used in sheet metal work, though black steel wire may be used as a substitute when the work is of a temporary nature. Wire diameters are designated and measured by gage number similar to metal sheets, as shown in table N-1.

Section III. FASTENERS FOR METAL DUCTS

10-6. Self-Tapping Screws

Self-tapping screws are used to hold sheet metal sheets together. Holes for the screws are punched or drilled slightly smaller than the screw diameter. The screw cuts its own thread as it is screwed into place.

10-7. Bolts

Stove bolts are used to fasten heavy metal parts together, to attach metal sheets to framework, and for other uses.

10-8. Rivets

Rivets are used to fasten two or more metal sheets together. The metal is first drilled to the rivet size. The rivet is then inserted through the hole and the stem flattened to hold the sheets together. Rivet size is based on weight per thousand. For example, one thousand No. 2 rivets weigh 2 pounds.

10-9. Solder

Galvanized and tin-coated iron sheets are joined by applying heat and a tin-lead solder. This is usually made of equal parts of tin and lead, though other proportions may be used. It is furnished in 1-pound bars. Wire solder with an acid core may be used to solder galvanized iron, and resin-core wire solder may be used to solder tinware.

10-10. Flux

Satisfactory soldering depends on complete cleanliness of the two pieces of metal to be joined. Surfaces must be free of dirt, oil, and metal oxide. The oxides of tin and zinc (formed by the action of oxygen in the air on the metal) are light gray in appearance and give a dull cast to the otherwise bright finish of the new metal. They should always be assumed to be present and steps taken to remove them before making a soldered joint. The following cleaning compounds, called fluxes, can be used.

a. Soldering Fluid. Soldering fluid is a noncorrosive liquid for removing oxide from all metal except copper. It will not burn hands or clothes.

b. Muriatic Acid. Muriatic or hydrochloric acid is used to clean galvanized metal and tin. Since it will burn skin and clothes it should be used with care.

c. Soldering Paste. Soldering pastes, usually or resin or tallow, are made to clean iron, tin, copper, and brass. Special pastes are made for various types of soldering jobs.

d. Sal Ammoniac. Sal ammoniac (ammonium chloride) is used to clean and flux soldering irons before use. It comes in cake form and should not be carried in tool boxes because it corrodes metal.

Section IV. QUALIFICATIONS AND DUTIES OF PERSONNEL USED IN FABRICATING AND ERECTING METAL DUCTS

10-11. Qualifications

The sheet metal force normally consists of a sheet metal foreman (senior noncommissioned officer in charge) and an adequate number of mechanics and helpers with the following qualifications:

a. The sheet metal foreman must know sheet metal practice and such regulations as pertain to it. He should be able to design and lay out all types of sheet metal work and have the experience the trade normally requires of a foreman.

b. Sheet metal mechanics must be able to lay out, make up, and install types of sheet metal work in normal use.

c. Sheet metal helpers should have experience as apprentices in the sheet metal trade.

10-12. Duties

a. The sheet metal foreman plans and directs the activities and delegates the duties for each man in his organization. He supervises all operations to assure compliance with safety and accident prevention measures.

b. Sheet metal mechanics lay out, assemble, and perform such other sheet metal work as assigned to them by the foreman.

Section V. EQUIPMENT

10-13. Handtools

The majority of sheet metal work involves the use of handtools. For efficient operation all tools must be kept in good working condition and stored in an accessible place to which they are returned after being used. Common sheet metal handtools (fig. 10-1) include:

a. Awls or Scribers. Used for marking lines on metal.

b. Dividers. Used for marking arcs and circles, and to transfer a line length from one object to another without the use of a ruler.

c. Squares. Used for laying out 90° at corners.

d. Protractors. Used for determining and laying out angles.

e. Trammel Points or Beam Compasses. Used for drawing large circles or arcs.

f. Rulers. Used for determining linear measurement.

g. Sheet Metal Gage. Used for determining the thickness of sheet metals in gage numbers.

h. Micrometer. Used for measuring sheet metal thickness.

i. Punches. All types. Special punches are designed for locating holes, center punching a mark for drilling a hole, and punching holes in sheet metal.

j. Grooves. Available in many types and sizes, used for forming and locking seams by hand.

k. Rivet Sets. Used for setting rivets and forming the finished rivet head.

l. Chisels. Available in various sizes and shapes, used to cut small metal projections (screws, rivets, etc.) and grooves or slots in large pieces of metal.

m. Hammers. Available in various sizes and shapes for particular jobs. (Be sure the correct hammer is being used. Types of hammers include chipping, ball peen, riveting, setting, raising, and common or clawhammer.)

n. Mallets. Made of wood (usually hickory), fiber, leather, or hard rubber, used in place of metal hammers to prevent damage or defacing metals.

o. Snips. Used for cutting sheet metal, available with shaped cutting edges to facilitate cutting circles, S-curves, straight lines, and curves.

p. Pliers. Used for gripping and working sheet metal.

q. Tongs (adaptations of pliers with wide jaws). Used to form and lock seams along the edges of metal sheets.

r. Coppers (soldering irons). Pieces of copper of various sizes and shapes attached to insulated handles. (Coppers are heated in small furnaces and supply the heat for soldering.)

s. Hacksaws. Used for cutting metal too heavy for shears where a smooth and accurate cut is required.

t. Files. Various sizes, shapes, and degrees of roughness to fit all surfaces and give the proper cutting action.

u. Stakes. Available in many sizes and shapes to form sheet metal to the desired shape of the end item. (Stakes are secured in metal bench plates specifically designed to fit stake shank.)

10-14. Shop Machinery (fig. 10-2)

Shop machinery includes both manually operated and power driven equipment. Sheet metal personnel should be thoroughly familiar with all types of equipment and trained in its operation. Inexperienced personnel should be warned against the unsupervised use of machinery both as protection to the personnel and to prevent damage to the equipment. Shop machinery includes, but is not limited to, the following:

a. Bar Folder. Bands edges of 22 gage or lighter metals.

b. Beading Machine. Forms a bead around the edges of 22 gage or lighter metals.

c. Bending Brake. Forms bends in 18-gage and lighter metals.

d. Burring Machine. Turns burrs on circular disks and prepares sharp folds or edges of cylindrical articles.

e. Crimping and Beading Machine. Crimps and beads the edges of metal sheets in one operation.

f. Drills. Both portable electric drills and drill presses are used to drill holes in heavy gage metal.

g. Edging Machine. Forms a border or edge along the edges of sheet metal.

h. Forming Machines. Forms sheets into curved or cylindrical shapes.

i. Grooving Machine. Shapes the edges of sheets for grooved seams and is extensively used for longitudinal seams or cylinders. Lock rollers are forms of grooving machines designed for developing the various roofing seams, drive cleats, and the Pittsburgh lock seam.

j. Shears. Special shears for slitting sheets, squaring edges, and cutting arcs or disks.

k. Welding equipment. Generally the only welding equipment found in a sheet metal shop is a spot welder. Equipment for continuous arc welding and brazing is usually confined to machine shops.

l. Miscellaneous Equipment. Many varieties of the above equipment are designed for specific operations rather than general purpose use. Examples of these machines would be brakes designed for forming the Pittsburgh lock seam, gutter beading machines, and double-seaming machines for double seaming flat battens.

10-15. On-the-Job Equipment

Set rules for what equipment should be carried cannot be established because of the variety of jobs encountered; therefore, it is up to the judgment of the foreman and sheet metal mechanics who plan the job to determine the necessary tools and equipment required to complete the work. All items and seams that can be fabricated in the shop should be completed before going out on the job to keep on-the-job time at a minimum.

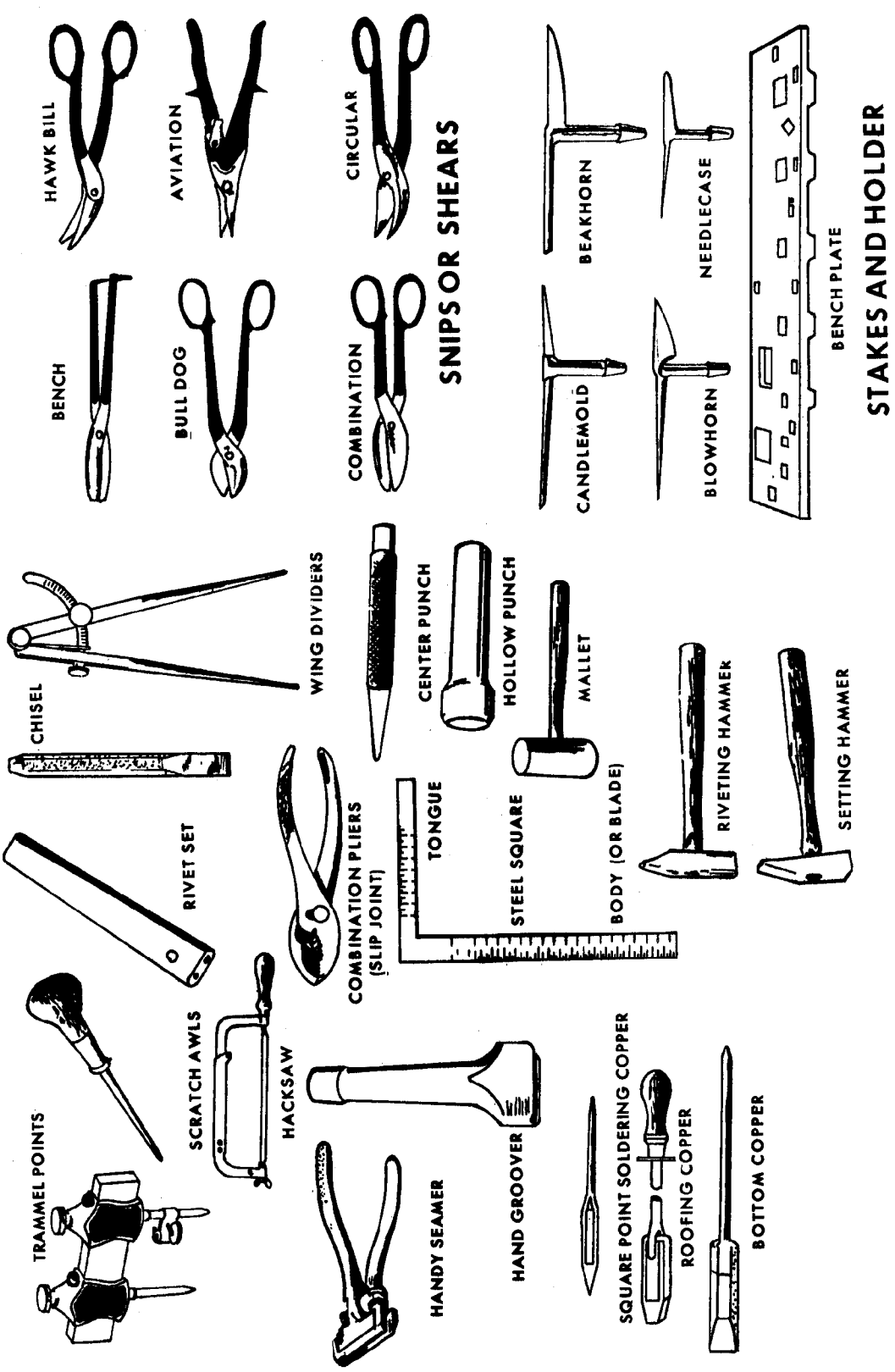

Figure 10–1. Common Handtools Used in Sheet Metal Work.

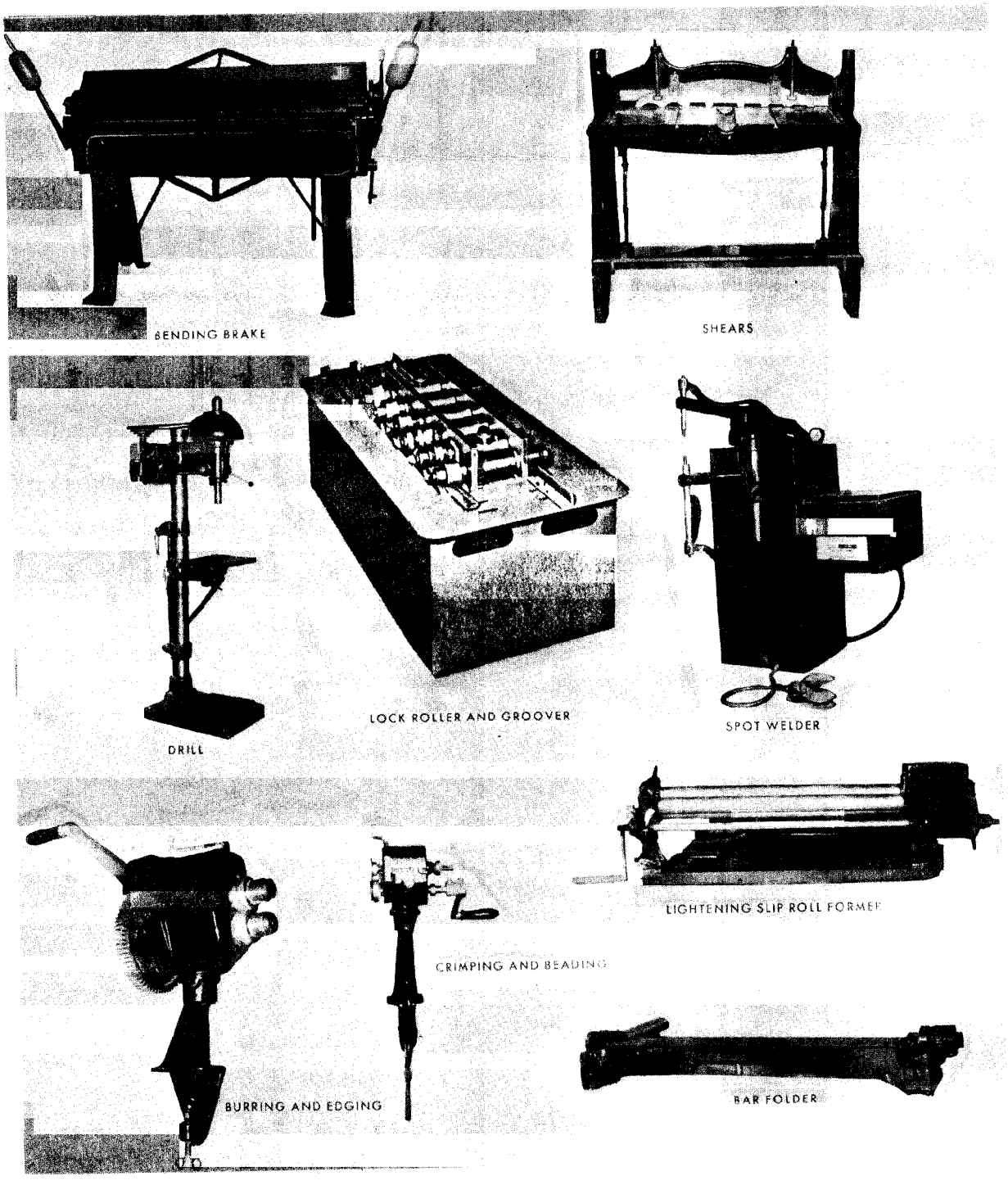

Figure 10–2. Typical shop equipment used in sheet-metal work.

Section VI. NONMETALLIC DUCTS

10-16. Formed Nonmetallic Duct

Formed nonmetallic duct has come into extensive use in recent years. This duct has limited strength and requires care in handling. The additional insulating value as well as ease of handling and installation makes it more useful in installations where traffic or abuse is limited.

10-17. Fiberglass Duct Systems

a. Characteristics.

(1) Fiberglass ducts are made of molded fiberglass fibers covered with a thin film coating, usually of aluminum, but vinyl or other plastic coatings are sometimes used. Since they are made of glass fibers the ducts are inherently insulated, and they find their greatest use on applications which require insulated ducts. Fiberglass meets Army regulations for flame spread rating of less than 25 and smoke developed rating of less than 50 for insulating materials. Wall thickness of fiberglass ducts allowed for use in Army installations must fall between ¾-inch to 2-inch depending upon the size of the duct.

(2) The nature of fiberglass ducts requires that it be supported with 1-inch by 1/16-inch galvanized steel strap hangers shaped to fit the duct. For round ducts, these supports must be on not less than six foot centers. Rectangular square ducts up to twenty-four inch span may be supported on eight foot centers. Ducts larger than twenty-four inches require support on four foot centers.

(3) The applicability of fiberglass ducts on heating systems sometimes is limited by the adhesive used to fix the protective outer covering to the fiberglass materials; and unless the aluminum surface duct is to be used, the specification of the duct used should be checked carefully to insure that it will not fail when heated over 250°F.

(4) Fiberglass ducts can be molded into a variety of shapes for special uses. Round ducts and reducers are available from manufacturers' stock. For most purposes, however, the duct is supplied flat in the form of a board, with V-grooves cut into the inner surface to allow folding to make a rectangular section. The ends of the boards are molded so that when the rectangular duct is formed, two sections of the same size will fit together in a shiplap joint to insure a tight joint in positive alinement. It is important to exercise care in selecting a board of adequate size to complete the desired duct before beginning cutting and grooving operations. In all cases, the inside diameter of the duct is the determining factor for board size. To determine board size see table 10-1.

b. Rectangular Ducts. To form a rectangular duct, the flat duct board is measured accurately and grooves are cut at the proper locations. The board is then folded to make the rectangular shape. When cutting the board, and overlapping tab is left and this is then pulled tight and stapled. Tape is applied and the joint is heat sealed. Joints between sections are made by pulling the shiplap end sections together, and completed by stapling taping and heat sealing the joint, as shown in figure 10-3.

Table 10–1. Duct Board Length Selection Chart

	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
6	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76
7	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78
8	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
9	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
10	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84
11	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86
12	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88
13	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90
14	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92
15	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94
16	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96
17	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98
18	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100
19	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102
20	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104
21	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106
22	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108
23	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
24	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112
25	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114
26	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116
27	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118
28	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120
29	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120	
30	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120		
31	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120			
32	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120				
33	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120					
34	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120						
35	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120							
36	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120								
37	94	96	98	100	102	104	106	108	110	112	114	116	118	120									
38	96	98	100	102	104	106	108	110	112	114	116	118	120										
39	98	100	102	104	106	108	110	112	114	116	118	120											
40	100	102	104	106	108	110	112	114	116	118	120												
41	102	104	106	108	110	112	114	116	118	120													
42	104	106	108	110	112	114	116	118	120														
43	106	108	110	112	114	116	118	120															

*For 1½-inch board—ADD 4 INCHES to these dimensions.

44	108	110	112	114	116	118	120
45	110	112	114	116	118	120	
46	112	114	116	118	120		
47	114	116	118	120			
48	116	118	120				
49	118	120					
50	120						

*For 2-inch board—ADD 8 INCHES to these dimensions.

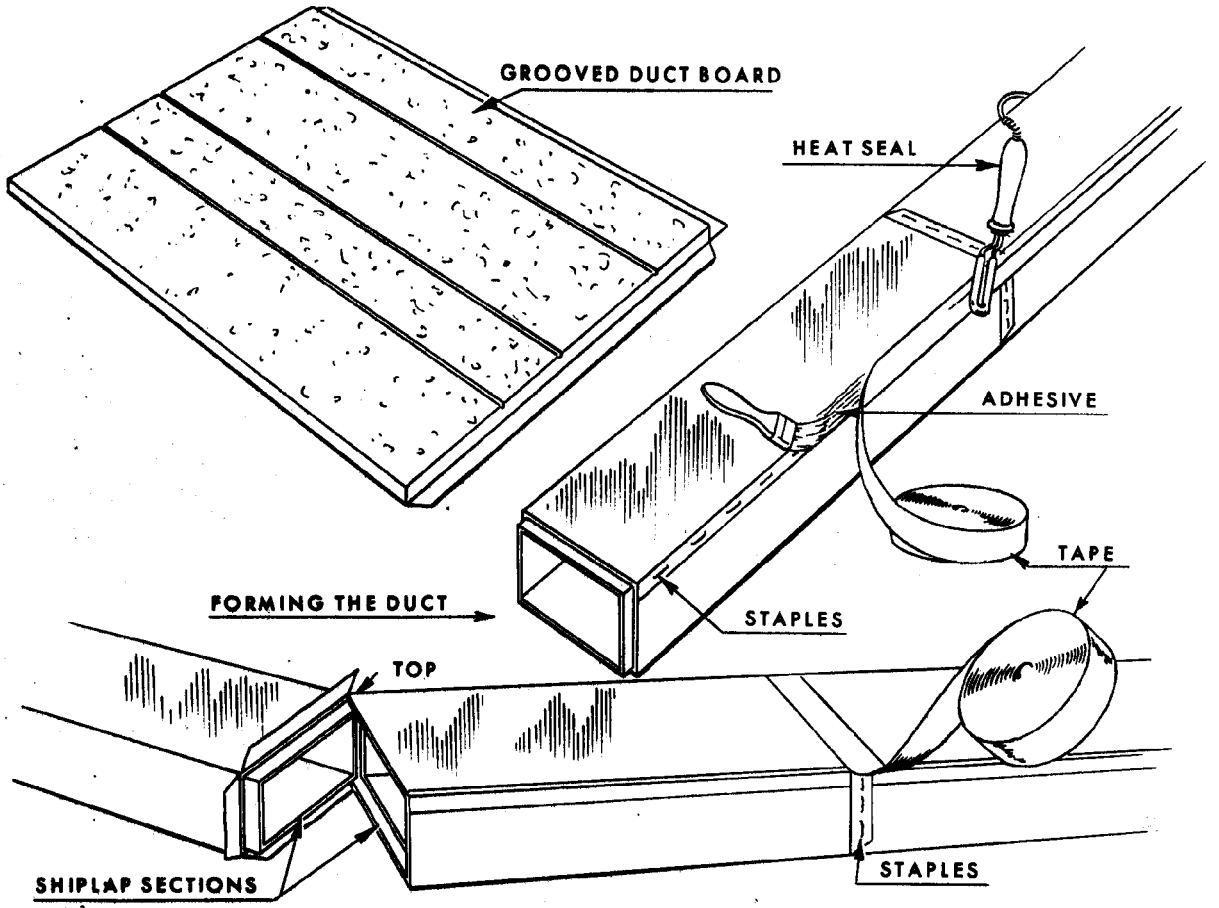

Figure 10-3. Forming rectangular or square fiber glass ducts from duct board.